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STATUS OF STATE REGISTRATION LAWS

By William M. Spann,[1] F. ASCE

SYNOPSIS

The course of registration laws in the United States is traced in this paper. The need for such laws is emphasized in telling the story of their growth. The degree of responsibility and position of national organizations toward registration laws and registrants is examined against the background of the individual states' own regulatory policies. The problems involved in not having a central national registration organization are presented. A plea is made for making registration the bade of recognition of the professional engineer, and a means of maintaining the high standards of practice that are the personal obligation and duty of the engineer toward his profession.

FUNDAMENTALS OF LICENSURE

Modern civilization has found it necessary to regulate the practices of persons whose activities deal with the protection of property and life so as to avoid dangerous, dishonest, incompetent, or unlawful engineering practices and in general to conserve the public welfare. Professional engineering registration laws, sponsored and developed by the engineering profession have been established to serve this purpose. Such laws provide a definite line of demarcation by separating those who improperly call themselves engineers from those who are legally qualified to practice engineering.

Licensing laws are based upon the police powers of the states, the power to enact any law deemed necessary for the protection of the property, peace, life, health, and safety of the inhabitants of the state. Registration laws, when

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[1] Cons. Engr., Tuttle-Ayers-Woodward Co., Kansas City, Mo.

properly drawn, have been upheld by the courts of the nation, so that the constitutionality of the mandatory registration regulations is unquestionable. Practically every design, every operation, and every process undertaken by engineers has public implications.

In the regulation of the practice of engineering, a definition must be included in the law, which will distinguish its activities from all others. It must be understood that registration laws require compliance only from those who offer their services to the public as professional engineers. Many engineers outside of public practice subscribe to the requirements of registration for reasons of prestige or position and stature, as well as for personal reasons to establish competence.

THE GROWTH OF REGISTRATION

In the early part of the century, a program of development in the conservation of water and the irrigation of arid lands was initiated in Wyoming. This program attracted many engineers to the area, some competent, but many of doubtful qualifications. Recognizing the need for some means of controlling the situation, the profession initiated and urged the adoption of a registration law, basing the practice of engineering upon the competence of the individual. Such a law was adopted and put into effect in Wyoming in 1907. Instances where loss of life or damage to property were attributed to the incompetence of the engineer caused concern among the profession, and stimulated activity in ways and means of measuring the ability of the practicing engineer and regulating his activities by license. Progress in setting up legislative procedures was slow at first, but gained momentum as its effectiveness was recognized, so that in 1959, the practice of engineering is regulated by registration laws in the 50 states of the United States and in Puerto Rico, the Canal Zone, and the District of Columbia.

On the basis of the 1950 census, extended by estimate to October, 1959, the major engineering groups are approximately as follows:

Electrical Engineers	19%
Mechanical Engineers	21%
Civil Engineers	23%
Aeronautical Engineers	3%
Other Engineering Fields	34%
Total Estimated Number of Engineers in U. S.	650,000.

As of June 1959, member boards of the National Council of State Boards of Engineering Examiners in the USA reported a total of 261,029 registrants in good standing, of which 234,183 are Professional Engineers, 14,096 are Professional Engineers and Land Surveyors, and 12,750 are Land Surveyors only. There are some duplications because many engineers are registered in several states, however, it is estimated that there are now 238,000 individuals registered as engineers in the United States and its territories. Thirty-seven of the boards register Land Surveyors. Administration of the two licenses is joint in all cases, except Texas, which has a separate board.

The census report indicated that of all persons employed as engineers, 12.2% had not completed high school and 45.5% had not completed 4 yr of college. It has been estimated that 80% of all the engineers in the United States are employed by industry and the Federal, state and local governments. The average turnover of this group in 1955 was 9%, which means that approximately 60,000 persons employed as engineers were on the move during

the year. Excessive turnover means both availability of jobs and dissatisfaction with employment, as well as lower productivity and increased cost. It has been estimated that numerically less than 10% or the nation's engineers are covered by collective bargaining.

STATUS OF REGISTRATION—THE SITUATION TODAY (1960)

While the practices and procedures in registration in the several states are quite variable, there is a marked tendency toward standardization and improvement of the individual laws to meet present day conditions, with an easing of the barriers on interstate practice. Since each state is an autonomous body, exchanges of courtesies must be made by agreements in accord with current regulations and legal limits contained in the state laws. Equivalence in requirements for qualifications is usually required and is a mandatory regulation. The day of full uniformity in interstate registration is far ahead, but excellent progress toward that goal has been made.

One major factor is that of accreditation of schools by the Engineers Council for Progressive Development (ECPD), which has been accepted as a requirement by over 41 of the boards. Another important factor in the development of registration has been the organization and maintenance of the National Council of State Boards of Engineering Examiners. This group is made up of the membership of the boards of each state and forms a cross-section of representative engineers from all branches of the engineering profession. By the exchange of ideas and with the support of the societies of the nation, as well as those from Canada, and the full cooperation of the state boards, marked progress and advancement in registration can be assured.

The framework of the laws of the states is quite similar in structure throughout the nation. The Model Law initiated in 1911 and sponsored since that date by the American Society of Civil Engineers (ASCE) has been used as a guide to improve and suggest standard procedures when amendments to existing laws are proposed. To those not familiar with general requirements, a look at average general procedures in the several states is of interest. The purpose of the licensing law is the same in all cases, to safeguard life, health, and property. It has also served to regulate the practice of engineering, and tends to serve as an aid in the upgrading of the engineering profession. Definitions of terms used in the laws cover the required items in variable language with material differences in meaning. Qualifications for registration, the requirement for proof of competence, vary in detail but usually with the same objective, that of competence to practice. The basic rule on qualifications acceptable to most boards is that of a degree from 4 yr of a college that is accredited by the ECPD with 4 yr of satisfactory engineering experience, plus passage of a 16 hr written examination.

The examination is usually divided into two parts, 8 hr on fundamentals and 8 hr on the practice of engineering. Several boards have variations of this requirement that give satisfactory equivalent results. Some boards accept long established practice and eminence for registration by endorsement, without the written examination.

Engineer-in-Training programs are in effect in some 45 states. This program permits the young engineer to make the first step toward his professional status by allowing him to take the written examination at the end of his school term, serving an apprenticeship in a professional atmosphere. It is usual to design the questions used on written examination on the basis

of the curricula used in the accredited state colleges. Applications are made on forms prescribed by the boards, accompanied by fees established by law.

The majority of states register persons as Professional Engineers, with no branch or field designated. On the basis of integrity and character, no engineer will attempt to practice in a field in which he is not qualified. Temporary or special permits are issued by some states pending qualification for full registration to practice. Exemption clauses, as contained in the registration laws, fall in several categories. In general these include

(a) U. S. Officials and employees.
(b) Elective officers of states, cities, counties, and so on.
(c) Employees of registered persons
(d) Manufacturers and incidental operations.
(e) Landscape architects and planners.
(f) Architects doing engineering work incidental to their own.
(g) Work not endangering the public welfare and for personal use.

Injunction proceedings necessary to restrain unlawful practice are contained in the laws of eight states. Others must make use of regular civil proceedings, such as are covered by local laws. So called corporate practice has long been a controversial subject because of the fact that under normal legal procedures, a license can be issued only to individual persons. Each board has its own fixed procedure on this subject. Because national registration is not possible, the National Council of State Boards of Engineering Examiners has established a committee on National Bureau of Engineering Registration, which has set up a standard for certification, to aid in interstate operations. This certification has been accepted as the qualification requirement for registration by thirty-five boards. Fifteen boards accept it as supplemental information and three boards do not accept it at all. This committee operates through the Executive Secretary of the Council at its office in Columbia, South Carolina. A total of 2,237 certificates have been issued up to July, 1959.

Enforcement of registration laws is always a problem. In most states, it is the duty of the constituted officers of the law of the state to enforce the provisions of the registration act. This is usually accomplished by and with the aid of the boards and the state engineering societies.

To illustrate the differences in practices in the several states, a tabulation was made from available data on some of the details that face the man who wishes to register in other states. All of these items do not have a bearing on competence of the individual, but do show lack of standardization in practices and requirements. There are some

(a) Forty separate and different ways to become a professional engineer (twenty-six boards accept degree plus 4 yr experience plus 16 hr exam);

(b) Nine ways to enroll as Engineer-in-Training (thirty-five accept degree plus 8 hr exam);

(c) Forty-four boards register as Professional Engineers, nine boards register by branches and fields;

(d) Thirty-five boards accept the National Bureau Certificate, fifteen use it as supplemental data;

(e) Forty-five boards require seal on all documents, eight boards require seal on recorded documents only;

(f) Thirty-one boards do not interview applicants, sixteen boards interview applicants, six boards interview occasionally as deemed necessary;

(g) Thirty-one boards reciprocate on an equivalent basis (the big question is interpretation of what equivalent means), twelve boards use or require equivalent written exams, seven boards use own discretion, others vary as to procedure;

(h) Eleven boards have no policy on older applicants, nine boards use proven reputation and practice, as a basis, eight boards use 35 yr old, plus 12 yr experience, with 4 yr responsible charge (here "responsible charge" has a variable definition).

The obvious remedy of course is to implement necessary balanced legislation based on agreements that will establish a similar realistic basis on qualifying requirements to cover the competence of the applicant, leaving the details of local and individual requirements to fit conditions that arise in each area. Personal ideas will always vary and cause interference in the arrangement of words (the problem of semantics) but with recognition and acceptance of the personal integrity and judgment and with a feeling of confidence in each other, boards will continue to make improvements in relations with each other in interstate practices.

Under any circumstance, anyone interested in becoming registered in another state should contact the secretary of the board in that state for full information and instructions.

INTEREST IN REGISTRATION

The engineering profession may be divided into three general areas of somewhat similar characteristics, but individualistic in interests. These groups are those in (a) private practice, (b) governmental agencies, and (c) industry.

This variety of operating interests creates differences of opinion that are in some ways coordinated by registration procedures. Activities in electronics and nuclear fields have created some problems in highly specialized categories because they are not included in many standard college curricula at this time. A better method of separating the classifications of scientists, engineers, and technicians for professional purposes and recognition seems desirable. It is significant that ASCE requires registration in the step from Member to Fellow, and National Society of Professional Engineers (NSPE) is made up of registered engineers.

THE NEED OF UNITY

Cooperation of the many units of the profession has been mentioned, with registration as a possible means of use as a common denominator. Each group of the profession has its own individual and technical interest, but each must recognize the need of unity, of unselfish effort for the support and well being of all in stimulating and advancing the welfare of engineers. Without registration, there is no way to (a) stop the practice of the non-engineer, (b) restrain use of the word "engineer" in offering services, (c) eliminate the incompetent in practice, and (d) reserve the rights of qualified engineers to practice their profession without restriction or hindrance.

The trend of progress in registration procedures has been gradual, but positive and steady, with such encouraging results that we can predict future advancement in all of its developments, for the convenience of the engineer

himself, the upgrading of the profession in the engineering world, and efficient service to the public.

Our engineering societies form an indispensable group foundation for the leadership and guidance of the profession. Group activity and interest are necessary factors in the preparation, formation, and maintenance of laws that restrict and regulate the practice of the profession that provides the livelihood of the engineer. Therefore, it is evident that each engineer should interest himself in registration, an activity that is so vital to his personal welfare.

RECOGNITION OF THE ENGINEER

Engineering is a profession that has been in the forefront of civilization since the world began, including such projects as the building of the pyramids, the hanging gardens of Babylon, and the roads of the Roman Empire. It is a profession that is one of the oldest in the history of science and that is in the forefront because of the part it plays in the reconstruction of the world of today to meet the demands of a modern civilization. It is a profession that cannot be kept alive by propaganda. Necessity and progress in all the arts make it imperative that we provide only the best in services and results. We must develop character in achievement, as well as skill and sound judgment, both of which are so essential.

We have the potential power to lift or lower the standards of our profession. It is a great responsibility, but as members of the profession, it is logical that other agencies should look to us and the other professional engineering societies for aggressive guidance toward unified action in practice and in ethical standards. Codes of ethics and canons of practice are the specifications that govern the implementation of professional practice in so far as relations with the services of the engineer are concerned. We should live by a code, the principles of which contribute to admiration and respect for all engineers. There are certain things that we might do that are legal, yet are prohibited by our voluntary acceptance of the code of ethics. We have provided for ourselves a standard of upright living, a refinement of conduct that is higher than is required by law. Violations of such rules are not usually included in registration laws, but do come within the scope of society regulations.

Much has been accomplished by ASCE, and credit is due those who have been instrumental in the cooperative and harmonious achievements that have brought us to our present stature and prestige that goes with membership in the Society. Ethical practices are vital to the welfare and pride of any professional group. The official certificate of registration received by an applicant attesting to the fact that he is licensed to practice, indicates only that the person has the minimum qualifications required by law and puts him under the jurisdiction of his board to control his activities. The integrity and character of the owner behind the symbolical certificate of registration is the major factor that protects the safety and welfare of the public. It seems only logical that this certificate will become the distinguishing mark of classification to separate the professional engineer from the technician.

Some of the effects of registration are as follows:

(1) Educational facilities have been improved and increased due to accreditation of curricula by the ECPD, supported by the state boards.

(2) Increased incentives for individual development after graduation, by requiring proof of competency for full registration privileges.

(3) Affords a sense of professionalism, of prestige.

(4) Affords a better public understanding by signifying responsibility and competence of the professional man.

(5) Registration is recognized as qualification for expert testimony by the courts.

(6) Requirements for qualifications acts as an elimination test to weed out incompetents.

(7) Registration established a legal basis to the public for practice in engineering.

A look at the developments in engineering registration over the past 50 yr (since 1910) proves its value without doubt. Registration will assume increasing status as a major element in the growth and advancement of engineering practice. Because of his qualifications, the engineer will be a leader in the future of the civilized world. The engineering profession is sadly lacking in public relations, in letting those who need our services know our capability, in telling the public about the major part we play in the necessary operations that affect everyday life. Justice Brandeis once said "nine-tenths of the serious controversies of life result from one man not knowing the facts which to the other man seems important, or failing to appreciate his point of view."

CONCLUSION

Registration has long been accepted and recognized by the general public as a means of designating those who can be called professional engineers. Recent trends have indicated an increased interest in the registration program by government, education, and industry by accepting it as a measure of desirability in moving toward a higher standard of qualifications and the establishment of prestige for the engineer.

To fulfill the obligations of a professional man, we must have interest, faith, and enthusiasm. Charles F. Kettering once said "we should have a lot of interest in the future, because that's where we will spend the rest of our lives."

We are an integral part of a group that aspires to reach a plane of eminence in the part the engineering profession plays in the development of the changing world, and to be a factor in providing the means for convenience and comfort that makes this earth of ours a better place in which to live.

Quoting from William Cullen Bryant

"So live, that when thy summons comes to join
The innumerable caravan that moves
To that mysterious realm where each shall take
His chamber in the silent halls of death,
Thou go not like the quarry slave at night,
Scourged to his dungen; but, sustained and soothed
By an unfaltering trust, approach thy grave,
Like one who wraps the drapery of his couch
About him, and lies down to pleasant dreams."

Let us make the certificate of registration the bade of recognition as a Professional Engineer, and do our part in maintaining high standards of practice as a personal obligation and duty to the engineering profession.

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MEANING OF THE PROFESSIONAL LICENSE TO ENGINEERS

By Donald Kowtko,[1] A. M. ASCE

SYNOPSIS

Many engineers obtain their professional engineering license each year, although most of them readily admit that they do not have direct use for it in their job. This paper presents the results of a survey outlining the tangible and intangible forces which motivate the engineer toward this goal.

INTRODUCTION

The aura that surrounds the title "professional engineer" is intriguing. It identifies a respected community of people who rank almost as high as doctors, lawyers, and bankers in the eyes of the people of this country.[2]

Many engineers employed today by large engineering firms have no direct need for registration. Yet, they are professional engineers or at least aspire to that title. However, an engineer rarely gets his license only because he needs it for his work. There seems to be certain less tangible benefits which, in reality, may be at least as important to the engineer-in-training as the direct use of his license.

When the engineer-in-training passes his final licensing exam, he becomes an "elite" member of his profession and enjoys a communal identity with other

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[1] Cost Engr., Esso Research and Engrg. Co., Linden, N. J.

[2] "Psychology of Industrial Behavior," by Henry Clay Smith, McGraw-Hill Book Co., Inc., New York, 1955, p. 88.

"professional engineers."[3] W. Wickenden expressed[4] this most eloquently when he said:

> ". . . . .a strong sense of comradeship and solidarity exists in all professional groups, whether it finds formal expression in a bar association or in the far-ranging talk of a group of artists around a cafe table. The sense of like-mindedness which comes from associating with men of superior talents and training in the pursuit of common goals and which puts service above gain, excellence above quantity, the rewards of self-expression above any pecuniary incentive, and a code of honor and courtesy above the competitive spirit, is one of the most dynamic of all the intangible forces in modern society."

The effort expended to study for an pass the licensing exams and the yearly fee which must be paid to maintain the license are substantial deterents if this license does not serve a meaningful purpose.

Is the main force which motivates engineers toward their goal explained by Mr. Wickenden, or there are other similar intabible forces which may be even more important to this group of engineers?

HYPOTHESES

This report will examine the relative importance of ten motivating forces which prompt engineers to obtain their professional engineering license. Besides establishing this order for the total group, the order of these factors will be examined for several sub-groups.

It is expected that the results of this study will prove the following four hypotheses to be correct.

A. An engineer who has direct application for his professional engineering license also enjoys a number of indirect benefits which are almost as important as the primary motivation.
B. An engineer who has no direct use for a professional engineering license and still obtains one is motivated by other strong basic needs.
C. The needs that a license satisfies for the "direct use" engineer are different, at least in order of importance, than for the "no direct use" engineer.
D. The order of importance of the needs which the professional engineering license satisfies for the following groups will be different for each group.

The Professional Group (P).—An engineer may identify himself with other people (1) belonging to the same professional societies, (2) holding the same degree(s) and/or (3) participating in the same engineering society functions.

The Social Group (S).—An engineer may identify himself as a member of a community and participate in neighborhood functions or social activities with his work group.

The Balanced Group (B).—Active engineers who participate in both professional and social groups lead a balanced life and may identify themselves as members of both groups.

The Inactive Group (I).—Engineers who do not participate in their engineering societies, community or company social activites do not identify themselves

[3] "Community Within a Community, the Professions," by William J. Goode, American Sociological Review, April, 1957, p. 195.

[4] "A Professional Guide for Junior Engineers," by William E. Wickenden, Engrs. Council for Professional Development, New York, 1949, p. 32-33.

with any immediately apparent group and are classified, for the purposes of this report, as inactive.

INDIRECT FACTORS WHICH MOTIVATE THE ENGINEER TO OBTAIN A PROFESSIONAL ENGINEERING LICENSE

There are many needs which motivate men in our modern society. These motivating forces are generally the same for different groups of workers. Although some forces are more important to one group then another, it is only a matter of degree of importance. These motivating forces are described by R. Stagner as follows:[5]

> "Security, as defined here by a steady job, seems to be a more potent motive than money as such. Other important desires include prestige (a chance to get ahead) and security in the sense of having a "square" boss, recognition (credit for the job you do), and so on. . . . . consciously, a worker does not think of the size of his paycheck as his main goal in industry."

The environment of a child affects what forces will be most important to him later in life. For example, if a child comes from an upper class family, he will have an advantage in home background, intelligence, and education, and aspire to a higher position in life than a child from a poorer home.[6]

In their work, men are constantly motivated by the forces which are important to them and achieve a certain degree of satisfaction from their job depending upon how well it fits their needs. The needs of professional and semi-professional groups were examined by R. H. Schaffer who found[7] the following ranked highest in need satisfaction:

> "1. Creativity and Challenge—The need for meeting new problems requiring initiative and inventiveness, and for producing new and original works."
> "2. Mastery and Achievement—The need to perform satisfactorily according to one's own standards. The need to perform well in accordance with the self perception of one's abilities."

The professional engineering license which many engineers obtain helps to satisfy some of these needs. After examining these basic needs, the following set of ten related factors was established.

1. Possible Application to Job.—Many engineers in industry today require a license so that they may certify the correctness and safety of a design. The trend indicates that even though an engineer may not need a license for his current job, the very next one may require him to testify in judicial proceedings as an expert witness on engineering matters. A court of law will consider him unqualified as an expert unless he is a registered professional engineer.[8]

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5 "Psychology of Industrial Conflict," by Ross Stagner, John Wiley and Sons, Inc., New York, 1956, p. 121.

6 Ibid., p. 108.

7 "Job Satisfaction as Related to Need Satisfaction in Work," by Robert H. Schaffer, Psychological Monographs: General and Applied, Vol. 67, No. 14, 1953, p. 17.

8 "Questions and Answers about Registration for Engineers in Industry," Engr.-in-Industry Committee, Natl. Soc. of Professional Engrs., Washington, D. C., p. 5.

Also, indications from industry are that registration may be required for every position of professional responsibility in industry. Since it will never be easier for qualified engineers to obtain a license, from the standpoint of stringent requirements and time lapse between education and a demonstration of required knowledge, the National Society of Professional Engineers urges engineers to become registered as soon as possible.[9]

Even though an engineer may not require his license today, a development may occur tomorrow which will make him thankful he has it. An engineer can easily rationalize a situation where his license is necessary and thus, possible job application may be a strong motivating force for any engineer to obtain his professional engineering license.

2. Higher Salary.— 73.5% of engineers indicate they chose that profession originally because of "engineering aptitudes" and only 12.3% gave "financial rewards" as their reason. However, other questions, asked of engineers by the National Society of Professional Engineers, indicate that the engineers's rate of pay becomes one of the most important factors in keeping him contented after he gets over his apprenticeship and the attendant glamour of entering a new profession.[10]

Because they monopolize a particular skill and are in essence a community of professional people, the members of a professional community obtain higher incomes than those of other occupations.[11]

> "A survey conducted by the Schenectady General Electric Engineers' Association of over 2,000 members of that group indicates that registered professional engineers enjoy an advantage both salary-wise and position-wise over their non-registered associates. The statistics show that the man with the license receives $2,000 to $2,500 a year more salary in the age level above 40 years. Below 40, the advantage is $500 to $1,000 a year."[12]

It is easy to see that registration is associated with higher income and an engineer who obtained his license may very well be seeking the higher salary that should eventually come along with it.

3. Job Security.—Job security is one of the most important of all motivating forces as indicated by the following remarks made in National Society of Professional Engineers publications:

> "Although they were still small boys when the great depression of the thirties ended, many young graduates of today still remember its dislocations and its effects, perhaps on their own families, and they want a safe berth for themselves in industry."[13]
>
> "All of the benefits and incentives enumerated above are of considerable value in holding employees, but those which are most effective, the survey showed, were those which closely linked with that primary goal of the engineer of 1954—security.

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[9] Ibid., p. 4.

[10] "How to Attract and Hold Engineering Talent," Professional Engrs. Conf. Bd. for Industry, Natl. Soc. of Professional Engrs., Washington, D. C., p. 23.

[11] "Community Within A Community: The Professions," by William J. Goode, American Sociological Review, April, 1957, p. 195.

[12] "Questions and Answers about Registration for Engineers in Industry," Engr.-in-Industry Committee, Natl. Soc. of Professional Engrs., Washington, D. C., pp. 3-4.

[13] "How to Attract and Hold Engineering Talent," Professional Engrs. Conf. Bd. for Industry, Natl. Soc. of Professional Engrs., Washington, D. C., p. 26.

"How important a part security plays in the plans of the average engineer is indicated by the fact that of 1,300 respondents to the questionnaire, 42 percent said they would not accept a higher-paying job with more responsibility if they were not assured of the same security of employment as existed in their current jobs."[14]

The second quote might be interpreted as an indication of job satisfaction except that 68% of this group said they are seeking other types of work with the same firms.[15]

P. Woodrow, personnel manager for Sun Oil Refinery at Marcus Hook, Pa. points to the company's stock purchase and pension plans as incentives for retaining professional personnel.

"Taken together," he said, "these two plans give them a very real sense of security, and that seems to be the primary goal of most of them nowadays."[16]

The engineer is obviously quite concerned with job security. The professional engineering license may be just another straw that he gathers up to make him more valuable to his company. Indireectly, it can increase his sense of security.

4. Greater Asset to Company.—The engineer strives for recognition from his company. If the company has any prestige value, recognition and praise by his company may motivate the engineer. N.P.S.E., in their description of a typical engineer from a recent survey says ". .he wants to stay with his firm. . .but he wants recognition as a professional and does not think he is getting it to the degree he should."[17]

The attitude of industry toward engineering registration is described as follows:

". . . . .over 75% of industrial employers actively encourage their engineers to become registered. In addition, many companies obviously favor registration as it enhances the firm's reputation to have large numbers of registered professional engineers on its staff."[18]

Since the employer looks favorably upon registration, an engineer will receive his company's praise when he obtains his license. This pat on the back may be very important to the engineer.

5. Higher Position in Your Lifetime.—As pointed out previously, a sense of achievement is a very basic need. This is, in fact, emphasized throughout the engineer's education each time he receives a grade. A professional group can control the behavior of its members.

"Professional life is so fundamentally based on achievement that such judgments of rank are made constantly. Indeed, rankings within the profession's area are a mode of social control."[19]

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14 Ibid., p. 37.
15 Ibid., p. 37.
16 Ibid., p. 30.
17 Ibid., p. 14.
18 "Questions and Answers about Registration for Engineers in Industry," Engr.-in-Industry Committee, Natl. Soc. of Professional Engrs., Washington, D. C., p. 5.
19 "Community Within a Community: The Professions," by William J. Goode, American Sociological Review, April, 1957, p. 198.

The engineer has a sense of achievement when he gets his license and feels he has advanced his position in life by becoming a member of this elite community, through meeting its rigid standards.

6. *Expected by Fellow Engineers.*—An engineer receives the impression that he is expected by his group (fellow engineers) to follow a certain path after graduation. By reading literature from engineer societies and professional groups the path is outlined in detail:

> "In addition to the foregoing suggestions, the young engineer will gain much for himself by promptly establishing an active membership in the national professional society of his chosen branch of the engineering field. By becoming an active participant in the meetings and social affairs of the nearest local section of such national society, whether it be in working with the reception committee or in presenting a technical paper or discussion, the individual will achieve a worthwhile sense of "belonging" in the world of adult affairs and will materially enhance his opportunity for self-improvement through the personal contacts and the experiences realized."[20]

Even more explicitly, his fellow engineers expect him to establish positive identification with the group as follows:

> "The aspirations of the engineering college graduate should be to become a professional engineer and to identify himself in the company of those who are qualified to practice in this profession. To acquire this privilege he must become a professional person in his thinking and his actions. Thus, professional registration offers to the young engineer a goal of personal development and an opportunity to serve mankind in a more responsible and privileged manner than that enjoyed by others not so qualified."[21]

7. *Fulfillment of Engineering Education.*—The undergraduate degree in engineering is not the end of their education for many engineers.

> "Such an affiliation is a major stepping stone for the attainment and continuance of the objective of recognized professional status which he set as his goal when he selected engineering as a career. By no other means can the engineer for so little gain so much in the way of insurance protection of his heavy investment of time, effort, and expense in the painstaking building of his educational foundation for a professional career in engineering."[22]

The undergraduate degree is certification of book-learning only. The professional engineering license however attests to practical experience also and, in a sense, is the important goal for which the eingineer strives.

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20 "A Professional Guide for Junior Engineers," by William E. Wickenden, Engrs. Council for Professional Development, New York, 1949, p. 7.

21 "The Importance of Registration in Improving the Status of Engineers," by John J. Uicker, Mechanical Engineering, December, 1956, p. 1104.

22 "A Professional Guide for Junior Engineers," by William E. Wickenden, Engrs. Council for Professional Development, New York, 1949, p. 38.

8. Social Equality with Fellow Engineers.—Along with the feeling that he is expected to get a license by his fellow engineers, an engineer may feel he cannot enjoy equality with the others until he has a license. Wickenden voices[23] the social aspects of professional groups as follows:

> ". . .a year's "ticket" to the local technical meetings as well as the regional and national meetings where fellow engineers in his chosen field discuss together the advances and the questions on the problems of the current day; a year's "ticket" to the social comradeship of his fellow engineers, and the life-long friendships which grow out of such activities and contacts?"

Although the primary reference here is to professional engineering societies, some feeling is present that you cannot really belong or participate socially with professional people unless you have your "ticket" which can also be a license. The relationship is similar to that of a pledge to a brother in a social fraternity.

9. Family Importance.—A more remote motivation for obtaining a license may be status in the eyes of the engineer's own family. The fact that his wife can say to her friends, "My husband is a professional engineer!" rather than "My busband works in the engineering department of So-and-So Company," may be a factor prompting the engineering toward registration.

10. Community Importance.—The professional engineer continually has ranked high in the list of most respected occupations.

> "Engineers have a responsibility as professional people to devote more attention to doing a better job of serving the public and then can merit greater confidence by the public. Such recognition of the efforts and accomplishments which have been made by the professional engineer now and formerly engaged in practice gives the young engineer a certain standing which has been earned for him by the profession. This automatically improves his status."[24]

A professional engineer automatically has certain status in his community and casual acquaintances and neighbors will probably look up to him and respect him because of the accomplishments of his profession. This status may be the important motivation for the engineer closely coupled with his community.

The ten factors noted cannot truly be separated from each other. Several may be linked together and a multiple motivation may be subconsciously behind a single answer. For instance, a man may say he got his license for the recognition it brings but this may subconsciously imply more pay also as a secondary motive.[25]

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23 Ibid., p. 39.

24 "The Importance of Registration in Improving the Status of Engineers," by John J. Uicker, Mechanical Engineering, December, 1956, p. 1103.

25 "Psychology of Industrial Conflict," by Ross Stagner, John Wiley and Sons, Inc., New York, 1956, p. 121.

Keeping this in mind, let us examine these factors for the different groups noted under the heading "Hypotheses" to see how each ranks the importance of these factors.

THE QUESTIONNAIRE

A questionnaire was prepared to prove or disprove the "hypotheses" outlined previously. The related factors which were to be examined in the questionnaire were discussed under the heading "Indirect factors which motivate the engineer to obtain a professional engineering license." The questionnaire was divided into six major par' 3. (See Appendix I for a sample questionnaire)

Personal Background.—The first several questions established some of the personal history of the engineer being polled. Of course, for the questionnaire to be of value the engineer must have a professional engineering license or anticipate obtaining one in the near future (questions 1 and 2).

Group Identification.—To place the engineer into one of the different groups posed in the hypotheses, several questions were required to indicate which groups, if any, were important to the engineer.

The answer to question 3 (Do you have any direct use for a professional engineering license in your present work? Yes No) gives the group division necessary to examine hypotheses A, B, and C.

The second breakdown (of the same set of responses) into the four groups for hypotheses D is more difficult. The criteria used to place the engineer into a group are as follows:

(P) Professional - 1. has two or more degrees
2. belongs to two or more professional societies
3. checked very or somewhat describing their activity in engineering societies

(S) Social - 1. checked very or somewhat describing their activity in engineering societies
2. checked very or somewhat describing their activity in their company's social activities

(B) Balanced - 1. any combination of one from each of the (P) and (S) criteria

(I) Inactive - 1. had only one degree
2. belonged to less than 2 professional societies
3. checked little or not at all for all of the activities

Qualitative Evaluation of Motivation.—The ten factors previously described are presented to the engineer, one at a time, allowing him to consider each separately and give, if possible, an absolute answer of yes or no. This prompts him to examine each factor on its own merit and establish its importance or unimportance as a motivating force for himself in his mind. By virtue of the percentage of yes answers here, we can get a rough check on the quantitative evaluation next.

Quantitative Evaluation of Motivation.—In questions 13, the engineer is asked to arrange these ten factors in descending order of importance. Thus the engineer critically weights one factor against the other and weeds out the less important factors. The important factors are easily picked out, but after

the first several choices the factors become significantly less important and a great deal of effort is probably not put into the order of the last several factors.

In the weighting of these items, therefore, only the first six factors have been scored, giving a 6 for first, 5 for second and so on. The total score for the ten factors in each group can then be used to establish their order of importance for that group.

Work Interest.—Questions 14 through 16 allow clarification of the engineer's attitude toward his job and work group.

Professional Interest.—The engineer is given an opportunity in questions 17 and 18 to indicate their opinion of today's licensing requirements and how any change might affect their own status.

THE GROUP SAMPLED

Six engineering firms of varying size in the metropolitan area were contacted and agreed to participate in the poll. Approximately 300 questionnaires

TABLE 1.—GROUP BREAKDOWN

No. (1)	Company name (2)	Direct use (3)	No direct use (4)	P (5)	S (6)	B (7)	I (8)	Total (9)
1.	Hazen & Sawyer	3	4	1	0	6	0	7
2.	Moran, Muesor, Proctor & Rutledge	5	8	6	1	4	2	13
3.	Dames & Moore	1	2	1	0	1	1	3
4.	Esso Research & Engineering Company	1	20	3	10	4	4	21
5.	Howard, Needles, Tammen & Bergendoff	9	25	7	11	14	2	34
6.	Tippets, Abbet, McCarthy & Stratton	6	40	10	9	20	7	46
	Totals	25	99	28	31	49	16	214

were sent out and 124 usable replies were returned. The participating companies and the group breakdown for each company is given in Table 1.

COMPARISON OF MOTIVATING FORCES FOR OBTAINING A PROFESSIONAL ENGINEERING LICENSE

Total Group Response.—The first purpose of this report is to find the important motivations for obtaining a professional engineering license for the total group. The tabulation of these factors (Table 2) and their ranking is extracted from Appendix II.

Examining, first, the weighted order of importance, one must conclude that the forces which motivate the average engineer to obtain a professional engineering license are the basic needs of opportunity for advancement, professional recognition, security, and a sense of personal achievement. These needs, in roughly the same order, are the prime requisites of job satisfaction for the engineer.[26]

26 "A Professional Guide for Junior Engineers," by William E. Wickenden, Engrs. Council for Professional Development, New York, 1949, p. 30.

The order of job preference factors obtained by various investigators is summarized by C. E. Jurgensen and the general consensus for male workers is as follows:[27]

1. Opportunity for advancement,
2. Steady work,
3. Opportunity to use your ideas,
4. Opportunity to learn a job, and
5. Opportunity to be of public service.

If we assume that the needs satisfied by obtaining a professional engineering license are equivalent to the needs of job satisfaction for the engineer, we find a reasonable correlation between the order in Table 2 and the preceding list.

In another article Jurgensen comments[28] on the relative rank of job security pointing out that, "Its importance decreased as extent of education increased." Directionally then, you would expect job security to be lower on a list for engineers, which in fact, it is.

TABLE 2.—ORDER OF IMPORTANCE FOR TOTAL GROUP

Factor (1)	Weighted order (2)	Yes - No order (3)
Higher position	1	1
Greater asset	2	4
Higher salary	3	5
Direct use	4	10
Job security	5	7
Fulfillment of education	6	9
Expected by fellow engineers	7	2
Social equality	8	8
Community importance	9	6
Family importance	10	3

Jurgensen also substantiates "higher position" as most important by showing it second (opportunity for advancement) in his own survey and remarking that its importance became greater as extent of education increased.[29]

Elmo Roper's survey also concluded[30] that American labor wanted essentially the same things in the following order:

1. Security,
2. Chance to advance,
3. To be treated like a human being, and
4. To feel a sense of individual importance.

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27 "Selected Factors Which Influence Job Preferences," by Clifford E. Jurgensen, Journal of Applied Psychology, Vol. 31, No. 6, December, 1947, p. 554.

28 "What Job Applicants Look For in a Company," by Clifford E. Jurgensen, Personnel Psychology, Vol. 1, No. 4, Winter, 1948, p. 436.

29 Ibid., p. 436.

30 "What Workers Want From Their Jobs," by Albert S. Thompson and Robert O. Goad, Employment Security Review, Vol. 16, No. 2, February, 1949, p. 11.

31 Ibid., pp. 12-13.

He also noted that men assigned greater value than did women to advancement and it also became more important as the amount of education increased.[31]

There also seems to be an explanation for the engineer's motivation of advancement and status taking precedence over job security which consistently ranks higher with workers.

First of all, the engineer employed by a large company is similar to any worker in industry in management's eyes.[32] John Mills also recognized the situation by describing engineers as being one step ahead of the upper class of workmen.[33] However, he later notes that the engineer sets his standards by that of executives.

> "Without realizing that he is of a class in aptitude distinct from that of executives, he judges the ceiling for his profession by their advancement and promotion. But his is set by the salary curve of his type. That their situation is not his he overlooks because of the human tendency always to see success is still prossible and just around the corner."[34]

Although a worker's circumstances make security of prime importance to him, the executive's motivating forces are upward mobility, prestige and status.[35] Since the engineer identifies his motives as similar to executive's motives, it is not surprising that advancement is so important to him.

The fact that the professional engineering license meant higher salary (ranked 4th) can be explained by the following:

> "However, registration in many firms is considered a major factor in evaluating employees for promotion, more responsible work and more opportunities for individual thought and discretion. A natural corollary to this is additional compensation."[36]

In other words, more money is a welcome secondary reward which naturally comes with achievement and recognition. Jurgensen also found pay ranked 5th in his survey and became more important as education increased.[37]

In re-examining Table 2, there are some notable discrepancies between the weighted rankings and yes-no rankings. The most striking is the high rank of Expected by Fellow Engineers (2nd) and Family Importance (3rd). When forced into an absolute choice here, a great many answered yes, but when asked to rank these against other motivating forces, they turned out not to be very important after all.

"Direct Use" versus "No Direct Use" Groups.—In order to verify hypotheses A, B, and C, the weighted rankings have been establish for two

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32 "How to Attract and Hold Engineering Talent," Professional Engrs. Conf. Ed. for Industry, Natl. Soc. of Professional Engrs., Washington, D. C., p. 33.

33 "The Engineer in Society," by John Mills, D. Van Nostrand Co., Ind., New York, 1946, p. 100.

34 Ibid., p. 125.

35 "Psychology of Industrial Conflict," by Ross Stagner, John Wiley and Sons, Inc., New York, 1946, p. 146.

36 "Questions and Answers about Registration for Engineers in Industry," Engr.-in-Industry Committee, Natl. Soc. of Professional Engrs., Washington, D. C., p. 3.

37 "What Job Applicants Look For in a Company," by Clifford E. Jurgensen, Personnel Psychology, Vol. 1, No. 4, Winter, 1948, p. 439.

groups: (1) engineers with a direct application for their license and (2) engineers with no direct application. The compared rankings are given in Table 3.

Except for reversals of order, the "no direct use" group compares reasonably well with the total group responses. The "direct use" group does differ substantially in several important items.

The ranking of direct use as the most important reason for obtaining a license is by no means surprising, however, greater asset actually received

TABLE 3.—ORDER (WEIGHTED) FOR "DIRECT USE" AND "NO DIRECT USE" ENGINEERS

Factor (1)	Total group (2)	Direct use (3)	No Direct use (4)
Higher position	1	3	1
Greater asset	2	2	3
Higher salary	3	4	2
Direct use	4	1	5
Job security	5	5	4
Fulfillment of education	6	6	7
Expected by fellow engineers	7	8	6
Social equality	8	7	8
Community importance	9	9	9
Family importance	10	10	10

TABLE 4.—ORDER OF IMPORTANCE - FOUR SUB-GROUPS COMPARED WITH TOTAL

Factor (1)	Total (2)	Professional (3)	Social (4)	Balanced (5)	Inactive (6)
Higher position	1	1	1	1	2
Greater asset	2	2	2	2	4
Higher salary	3	3	3	3	3
Direct use	4	4	5	4	5
Job security	5	5	4	5	1
Fulfillment of education	6	6	6	7	7
Expected by fellow engineers	7	7	7	6	6
Social equality	8	8	8	9	8
Community importance	9	9	10	8	9
Family importance	10	10	9	10	10

as many points in the weighted scores. It as placed second based on the yes-no ratings. Logically, this choice of greater asset as second seems justified since the company recognizes the "direct use" engineer's professional competence by giving him the opportunity to use it.[38]

The "no direct use" engineer drops possible job application only to fifth based on the rationalization that he will not always be in his present position and might very well need it tomorrow.[39]

38 "Questions and Answers about Registration for Engineers in Industry," Engr.-in-Industry Committee, Natl. Soc. of Professional Engrs., Washington, D. C., p. 4.

39 "Next Step-Registration," Natl. Soc. of Professional Engrs., Washington, D. C., p. 3.

Since the "direct use" engineer scored greater asset and higher position very strongly, hypothesis A appears to be correct. This group of engineers does enjoy a number of indirect benefits along with the direct use they have for professional engineering license.

The "no direct use" engineers indicated that registration satisfies a number of strong basic needs which justifies their effort to obtain the license. The weighted rankings show hypothesis B to be correct also.

The difference in rankings of higher position and direct use plus other minor changes indicates that the order of importance of factors is different for "direct use" and "no direct use" engineers. Thus, hypothesis C is accurate although the differences are not as great as was originally expected.

Effect of Group Identification on Motivating Forces.—The last hypothesis indicates that four groups would show different orders of importance. These groups and the weighted orders taken from Appendix II are noted in Table 4.

The professional, social, and balanced groups agree almost completely with the total group ratings, and also with each other. The only group showing any significant difference is the inactive group. This last group ranks job security much higher than other groups.

The personal background shows no reason why the inactive group responds differently except for the fact that they do not strongly associate themselves with any other group of people. (This, of course, is how this inactive category was defined.) Their work interest, however, indicates all of them expect to remain in engineering work for the next 10 yr and fewer of them would consider a management position.

Thus, they do not have the aspirations of the "average" engineer who looks toward the same goals as executives do. The "inactive" engineer is more similar in his motivation to the worker, looking primarily for job security and at his professional engineering license as supplying him with this.

Hypothesis D is therefore incorrect. Based on the results given in Table 4, the corrected hypothesis should be:

Hypothesis D: The order of importance of the needs which registration satisfies for the engineer will be the same if he identifies himself with a professional or social group. The order will be somewhat different if the engineer has no strong group identification.

CONCLUSIONS

This report has briefly examined the motivations which prompt an engineer to obtain his professional engineering license. The order that the "average" engineer ranked the ten factors presented was:

1. A professional engineering license will help me to achieve a higher position during my lifetime.
2. I am a greater asset to my company with a professional engineering license.
3. My license will allow me to command a higher salary in industry.
4. I got my license because it may have direct application to my job.
5. A professional engineering license provides me with job security because I have something more to offer my company.
6. Registration is the fulfillment of my engineering education.
7. My fellow engineers expect me to obtain my professional engineering license.

8. I need my license to maintain social equality with other engineers.
9. My neighbors respect my opinions because I am a professional engineer.
10. My family feels it is important for me to have my professional engineering license.

Because of the relatively weak response for items 8, 9, and 10, they are not significant motivating factors for the average engineer.

The order of importance of these factors changes much less than expected even when comparing such drastically different groups as engineers who have a direct use and those who have no direct application for their license.

Although this report was used to determine licensing motivations, it may also express the basic elements of job satisfaction for engineers. No published research which listed an exact order for engineers but the general consensus of other surveys for other groups seems to indicate that the order should be very similar to the list noted above. General discussions of other surveys made by N.S.P.E. and E.C.P.D. indicate the list is basically correct.

ACKNOWLEDGMENTS

This paper is dedicated to engineers who strive to obtain their professional engineering licenses without any apparent need for it. I would like to thank the 124 of them who answered my questions and provided the basis to establish the hidden meaning of a professional engineering license.

ADDITIONAL REFERENCES

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3. "Report of Committee on Effects of Registration," by C. C. Knipmeyer, Reprint from Proceedings of Annual Meeting of the Natl. Council of State Bds. of Engrg. Examiners, Chicago, Ill., October 9-11, 1950.
4. "The Machine, The Worker, and the Engineer," by Robert K. Merton, Science, Vol. 105, January-June, 1947, pp. 79-84.
5. "Registration—a Dream Come True," by D. B. Steiman, Address at Annual Meeting Banquet of the Natl. Council of State Bds. of Engrg. Examiners, Daytona Beach, Flordia, November 11, 1949.
6. "What Workers Mean by Security," by Albert S. Thompson, Personnel Psychology, Vol. 9, No. 2, Summer, 1956, pp. 229-241.
7. "Occupational Mobility of Scientific and Technical Personnel," by Helen Wood, Occupations, Vol. 28, No. 8, May, 1950, pp. 510-513.

APPENDIX I

November 21, 1959

Dear

You probably have obtained or at least have considered obtaining a professional engineering license. The licensing exam requires a good deal of review on the part of the applicant and a yearly fee to maintain the license. This license, therefore, must be worth the cost and effort spent by the applicant to obtain it.

The meaning of this license and the various reasons it is important to engineers is, at best, hazy. I am presently trying to establish the motivations that make a Professional Engineering License such a sought after goal by engineers.

By filling out the attached questionnaire, you can help me to pinpoint the important meaning of a P. E. License to engineers. Please send the completed form back to me as soon as possible and do not sign it.

Sincerely yours,

Donald Kowtko

DK/ek/jek
Enc.

RETURN TO:

DONALD KOWTKO
Room D-244

THE USES & MEANING OF A PROFESSIONAL ENGINEERING LICENSE

Please fill out the following questionnaire and return to Donald Kowtko as soon as possible. Do not sign your name to the questionnaire.

Occupation: _____

Degrees: 1. _____

2. _____

3. _____

Married _____ Single _____

No. of Children _____

Home Owner: ☐ Yes ☐ No

Age: _____ Years

How active are you in professional engineering societies?

☐ Very ☐ Little

☐ Somewhat ☐ Not at All

How active are you in your community?

☐ Very ☐ Little

☐ Somewhat ☐ Not at all

List the professional engineering societies to which you now belong:

1. _____

2. _____

3. _____

How active are you in company social activities?

☐ Very ☐ Little

☐ Somewhat ☐ Not at all

1. Do you have a Professional Engineering License? ☐ Yes ☐ No
   a. Did you take a refresher course to help you prepare for the exam? ☐ Yes ☐ No
2. Do you intend to obtain your license in the near future? ☐ Yes ☐ No
   a. Do you intend to take a refresher course to help you prepare for the exam? ☐ Yes ☐ No
3. Do you have direct use for a P.E. License in your present work? ☐ Yes ☐ No
   a. If Yes, what type of work? _____

   _____

   b. If No, what direct use can you see for a license in the near future?

   _____

   _____
4. Do you feel that a P.E. License will allow you to command a higher salary in industry? ☐ Yes ☐ No
5. Do you feel that a P.E. License will provide you with Job security because you have something extra to offer your company? ☐ Yes ☐ No

6. Do you feel that you would be a greater asset to your company in your present position with a P.E. License? ☐ Yes ☐ No

7. Do you feel that a P.E. License can help you achieve a higher position during your lifetime than if you did not have it? ☐ Yes ☐ No

8. Do you feel that your fellow engineers expect you to obtain your license? ☐ Yes ☐ No

9. Do you look at the Professional Engineering License as the fulfillment of your engineering education? ☐ Yes ☐ No

10. Do you feel that a P.E. License is necessary for you to maintain social equality with other engineers? ☐ Yes ☐ No

11. Does your family feel that a P.E. License is important to your position? ☐ Yes ☐ No

12. Do you feel that your neighbors might ask you advice on home construction and repair problems knowing that you are a licensed engineer? ☐ Yes ☐ No

13. You have just gone through 10 reasons that an engineer may obtain a professional engineering license. They are relisted below. Arrange them in descending order of importance for yourself.

Most Important _____ ↓ _____ Least Important _____

a. direct application to your job
b. command a higher salary
c. job security
d. greater asset to company
e. higher position
f. expected by fellow engineers
g. fulfillment of engineering education
h. social equality with other engineers
i. family importance
j. community importance
k. other _____

14. Roughly, how many engineers in your immediate group have their P. E. License? _____%

15. Do you intend to remain in engineering or some other phase of technical work for the next, say, 10 years? ☐ Yes ☐ No

16. If given an opportunity to advance into a management position which had no direct technical aspects to the job, would you consider it seriously? ☐ Yes ☐ No

17. How do you feel about today's requirements for a P.E. License?

☐ Too strict - make easier
☐ All right
☐ Too easy - make stricter

18. If you had a P.E. License, how do you feel the change you recommended in question 17 would affect your professional status? _____

APPENDIX II

TABLE 5.—QUESTIONNAIRE RESPONSES[a]

QUESTION (1)		DI-RECT (2)	NO DI-RECT (3)	P (4)	S (5)	B (6)	I (7)	TOTAL (8)
A. PERSONAL BACKGROUND								
No. of Degrees	1	.54	.53	.25	.97	.36	.73	.53
	2	.42	.41	.61	.03	.58	.27	.41
	3	.04	.06	.14	.00	.06	.00	.06
Married		.89	.87	.90	.90	.88	.81	.87
Single		.11	.13	.10	.10	.12	.19	.13
No. of Children	0	.31	.26	.33	.22	.26	.25	.27
	1-2	.38	.55	.56	.50	.49	.56	.52
	3+	.31	.19	.11	.28	.25	.19	.21
Home Owner	Yes	.48	.56	.53	.62	.51	.50	.54
	No	.52	.44	.49	.38	.49	.50	.46
Age	Under 25	.04	.02	.00	.02	.02	.06	.03
	26-29	.23	.32	.32	.27	.33	.25	.30
	30-34	.34	.29	.29	.37	.31	.19	.30
	35-59	.12	.13	.18	.17	.12	.00	.13
	40 & Over	.27	.24	.21	.17	.22	.50	.24
No. of Engineering Societies	0	.08	.26	.11	.50	.04	.44	.21
	1	.46	.42	.36	.50	.39	.56	.43
	2	.38	.21	.39	.00	.39	.00	.24
	3	.08	.11	.14	.00	.18	.00	.11
B. GROUP IDENTIFICATION								
Active in Professional Engineering Societies?								
	Very	.08	.04	.04	.00	.10	.00	.05
	Somewhat	.38	.24	.32	.00	.49	.00	.27
	Little	.31	.35	.36	.43	.33	.19	.34
	Not At All	.23	.37	.28	.57	.08	.81	.34
Active in Community?								
	Very	.04	.04	.00	.07	.06	.00	.04
	Somewhat	.46	.32	.00	.64	.47	.06	.35
	Little	.27	.37	.44	.13	.37	.50	.35
	Not at All	.23	.27	.56	.16	.10	.44	.26
Active in Company Social Activities?								
	Very	.15	.10	.00	.13	.21	.00	.11
	Somewhat	.35	.38	.00	.50	.61	.00	.37
	Little	.31	.30	.59	.20	.08	.69	.31
	Not At All	.19	.22	.41	.17	.10	.31	.21
1. Do you have a P. E. License?	Yes	.58	.52	.56	.30	.60	.69	.53
	No	.42	.48	.44	.70	.40	.31	.47
1A. Did you take a refresher course?	Yes	.27	.47	.59	.44	.34	.36	.42
	No	.73	.53	.41	.56	.66	.64	.58
2. Do you intend to obtain your P. E. License?	Yes	.42	.48	.44	.70	.40	.31	.47
	No	.58	.52	.56	.30	.60	.69	.53
2A. Do you intend to take a refresher course?	Yes	.64	.72	.50	.72	.75	1.00	.70
	No	.36	.28	.50	.28	.25	.00	.30

TABLE 5.— *CONTINUED*

QUESTION (1)		DIRECT (2)	NO DIRECT (3)	P (4)	S (5)	B (6)	I (7)	TOTAL (8)
C. QUANITATIVE EVALUATION OF MOTIVES								
3. Have direct use for license?	Yes	1.00	.00	.18	.10	.31	.19	.21
	No	.00	1.00	.82	.90	.69	.81	.79
4. Command a higher salary?	Yes	.68	.52	.57	.58	.60	.63	.56
	No	.32	.48	.43	.42	.40	.37	.44
5. Provide you with job security?	Yes	.46	.38	.25	.43	.38	.63	.39
	No	.54	.62	.75	.57	.62	.37	.61
6. Greater asset to your company?	Yes	.92	.48	.54	.43	.64	.62	.57
	No	.08	.52	.46	.57	.36	.38	.43
7. Help you achieve higher position in lifetime?	Yes	.96	.86	.89	.80	.98	.87	.90
	No	.04	.14	.11	.20	.02	.13	.10
8. Expected by fellow engineers?	Yes	.76	.62	.52	.52	.81	.60	.65
	No	.24	.38	.48	.48	.19	.40	.35
9. Fulfillment of your eng'r. education?	Yes	.20	.23	.22	.27	.18	.25	.22
	No	.80	.77	.78	.73	.82	.75	.78
10. License necessary for social equality?	Yes	.35	.31	.17	.38	.35	.38	.31
	No	.65	.69	.83	.62	.65	.62	.69
11. Your family feel license is imp.?	Yes	.60	.57	.50	.52	.65	.60	.58
	No	.40	.43	.50	.48	.35	.40	.42
12. Your neighbors recognize imp.?	Yes	.46	.45	.32	.44	.55	.38	.45
	No	.54	.55	.68	.56	.45	.62	.55
D. QUANTITATIVE EVALUATION OF MOTIVES								
13. a. direct use		113	157	61	55	116	38	270
b. higher salary		64	312	90	89	146	51	376
c. job security		41	222	51	67	93	52	263
d. greater asset		113	293	99	98	170	39	406
e. higher position		84	385	116	122	182	51	469
f. fellow engineers		13	143	31	32	70	21	154
g. fulfillment		34	131	41	47	61	16	165
h. social equality		13	77	20	29	32	9	90
i. family importance		2	59	17	18	21	5	61
j. community importance		5	72	18	14	37	8	77
E. WORK INTEREST								
14. Work group have licenses %								
	0-25	.38	.30	.30	.52	.19	.44	.32
	25-50	.12	.21	.18	.22	.21	.06	.19
	50-75	.35	.32	.30	.22	.41	.25	.32
	75-100	.15	.17	.22	.04	.19	.25	.17
15. You intend to remain in eng'r. work?	Yes	.96	.93	.96	.86	.94	1.00	.93
	No	.04	.07	.04	.14	.06	.00	.07
16. You consider a management position?	Yes	.73	.85	.75	.90	.88	.69	.83
	No	.27	.15	.25	.10	.12	.31	.17
F. PROFESSIONAL INTEREST								
17. Today's requirements for a P.E. License?								
Too strict		.04	.03	.04	.07	.00	.07	.03
OK		.63	.72	.64	.68	.78	.57	.70
Too Easy		.33	.25	.32	.25	.22	.36	.27
18. Would recommend change:								
1. Increase your status		3	20	9	7	6	1	23
2. Decrease your status		0	0	0	0	0	0	0

[a] All figures given as fraction of total group answering question:
DIRECT = direct use group
NO DIRECT = no direct use group
P = Professional group
S = Social group
B = Balanced group
I = Inactive group

Journal of

PROFESSIONAL PRACTICE

Proceedings of the American Society of Civil Engineers

DISCUSSION

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SIX THOUSAND HIGH SCHOOL STUDENTS VIEW ENGINEERING AND SCIENTIFIC CAREERS[a]

Closure by the Committee

STUDENT ACTIVITIES COMMITTEE, SAN DIEGO SECTION, ASCE.—The committee is gratified by the nationwide interest stimulated by the publication of this paper. The paper has been the subject of numerous newspaper editorials across the country; in June 1959, it was presented before the Pittsburgh Conference of the American Society of Engineering Education.

In addition, a follow-up questionnaire along similar lines has already been started by the San Diego County Schools. A communication from the Office of the San Diego County Superintendent of Schools outlines their plans as follows:

> "Plans have been made by members of the Department of Education, San Diego County, for a follow-up questionnaire and study of vocational choices of students in selected high schools in the County. The participating schools were chosen to provide samples from schools of different sizes and community backgrounds. These plans, developed last year, resulted in a project approved under the provisions of the National Defense Education Act, and money has been allocated for I.B.M. tabulation of the questionnaires, which were administered last spring shortly after approval had been received. Analysis of the results will be completed during the present school year."

This new questionnaire was administered to 4,850 students in grades 10, 11, and 12, in six high schools within the county, 4 of which were represented in the original compilation.

The results of this tabulation will indicate any changes in student interests from the "pre-sputnik" to the "post-sputnik" periods.

This was intended to be strictly a statistical paper and the committee has intentionally refrained from attempting to interpret any of the trends indicated by student interests or lack of interests. Such interpretations did not fall within the scope of the committee's assignment. It is the committee's feeling that the engineering educators are far better qualified to make such interpretations and recommendations.

Two points, however, seem to stand out in the minds of the committee that might bear further study by others:

1. Stimulating the interest of students prior to the 10th grade; and
2. Making the subject matter more enjoyable to the students.

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[a] December, 1958, by the Student Activities Committee, San Diego Sect., ASCE.

The committee would like to take this opportunity to express its sincere thanks to the Office of the San Diego County Superintendent of Schools for its efforts and assistance, and also to the Committee on Engineering Education, Los Angeles Section, ASCE, for their discussion of the paper. Their comments relating to the schools in the Los Angeles area were very interesting.

PITY THE POOR PROFESSORS?—OR PROPAGATE THEM![a]

Closure by Jack E. McKee

JACK E. McKEE,[1] F.ASCE.—It is most gratifying to note that none of the written discussions have taken issue with the major premise of this paper, namely, that the number and quality of engineering professors should be improved by positive action rather than be diminished by pity and scorn. Not until the true merits and awards of an academic career are recognized and publicized will the best yound minds be attracted to this important segment of our profession. Messrs. Streeter, Elleby, and Butrico appear to support these major premises and augment them by additional arguments or by corollary observations.

In preparing the original paper, the writer was cognizant of the many nonmonetary awards of the academic life, as delineated so ably by Mr. Streeter. Indeed, these factors generally motivate engineers to select a combination of teaching and research as a career. Without these advantages very few professors would remain in their cloistered life. In the past, however, Mr. Streeter's advantages have been offered as reqards partially in lieu of adequate monetary compensation. This substitution, fortunately, has largely disappeared, now that academic salaries with outside income are sufficient inducements in themselves to justify selection of a career in teaching and research. The writer is grateful, nevertheless, that Mr. Streeter has reiterated the many advantages of a university position that augment the monetary considerations.

In describing the financial difficulties of graduate assistants and part-time instructors working toward doctoral degrees, Mr. Elleby has hit on a difficult problem indeed. His portrayal of the life of a young married graduate student is all too true, and it emphasizes the sacrifice that a man must endure in order to qualify for the better academic positions.

What can be done to alleviate this condition so that the hurdle from the baccalaureate degree to an assistant professorship will not be so costly in lost income? One solution, admittedly unrealistic, would be to urge doctoral candidates to postpone marriage, or at least children, until a full-time academic position is assured. Such a suggestion would drive away many of the most able candidates for, as Mr. Elleby so ably contends, young engineers hestitate to sacrifice living standards and a natural home life during 4 yr of graduate study.

In support of Mr. Elleby's thesis, the writer recalls that upon receiving a BS degree in 1936, he had the choice of a governmental position at $105 per month or a graduate teaching assistantship that netted $90 a month. The monetary discrepancy between a full-time engineering appointment and the stepping stone to an academic career was relatively insignificant. Today,

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[a] December, 1958, by Jack E. McKee.

[1] Prof. of San. Engrg., Calif. Inst. of Tech., Pasadena, Calif.

however, the recipient of a bachelor's degree must forego $500 a month or even more in order to accept a teaching assistantship paying $150 to $200 a month. The ratio has changed markedly. Is it any wonder that we have difficulty persuading our best young men to sacrifice this income differential for 4 yr in order to qualify for good academic appointments?

The solution to this dilemma lies in increased compensation for teaching assistants and part-time instructors. Fortunately, the trend toward increase is already evident, being stimlated by more-remunerative fellowships and traineeships available through NSF, NDEA, AEC, USPHS, other governmental agencies, and private philanthropic organizations.

One of the most far-sighted agencies in promoting graduate study and stimulating young engineers to enter the teaching profession has been the U.S. Public Health Service. Mr. Butrico referred briefly, and far too modestly, to the fine efforts of this agency and to his own part in providing traineeships, research fellowships, and training grants for graduate students. In addition, the USPHS has provided supplemental income for regular academic personnel through consultatory fees, summer employment, and research grants. As a consequence, sanitary engineers have had an advantage over some of the other categories of engineering professors.

Mr. Butrico wisely observes that the danger is ever present that outside activity will detract from the educator's primary obligation to his students. He is certainly correct and indeed, this condition may exist already for some of us. For this reason, it is important that universities maintain the restriction that not more than one day a week on the average be allowed for outside work.

IMPORTANCE OF EMPHASIS IN CIVIL ENGINEERING EDUCATION[a]

Closure by L.E.Grinter

L.E. GRINTER,[1] F. ASCE.—The writer is pleased with the attitudes expressed so clearly by the discussers. Messrs. Stretter, Posey, Kiker, and Johnson are four of the most experienced teachers and four of the best minds in civil engineering education. Their views and attitudes need to be given the most thoughtful consideration. In closing this discussion of the education of civil engineers, the writer would like to reemphasize the obligation of civil engineering teachers, and in fact all teachers of engineering to insist that engineering education keep up with progress in science and technology.

In any generation except the last two or three, knowledge could be treated as static without serious effect on education. Now, knowledge must be treated as dynamic, for it is a most serious influence on educational procedures and on professors' lives. In engineering education the most dynamic influence has been science, whereas the most nearly static areas have been the engineering arts, techniques, and skills. Because the teaching of a rapidly changing area is so highly demanding upon the teacher, it is to be expected that engineering courses retain a high percentage of whatever art is thought to be "relatively stable" even though it is largely non-transferrable to other engineering situations.

The weakness of the argument that curricula should be based largely on humanities, basic science, and engineering science is that a considerable fraction of engineering graduates never do any work in design or in research. However, we should compare the scant non-engineering preparation of engineers with the more extensive background required of doctors and lawyers, most of whom practice outside the areas of research or creative activity.

If engineering cannot compete in educational requirements with other professions, then it needs to consider whether it must not separate a considerable fraction of engineering students, at least a quarter, into curricula or options designed to produce research and development personnel and creative designers. The responsibility has been placed on the engineering colleges by society for the training of creative designers and research engineers. For two or three generations, the percentage of such minds that atuomatically developed out of the mass of our graduates appeared to be sufficient for the needs of our country. This is no longer true. All curricula must, therefore, be oriented more strongly in this direction, or special curricula or options must be given the central responsibility of producing creative engineers and applied scientists.

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[a] December, 1958, by L. E. Grinter.

[1] Dean, Graduate School and Dir. of Research, Graduate School, Univ. of Florida, Gainesville, Fla.

SPUTNIKS, FLOPNIKS, AND ENGINEERING EDUCATION[a]

Closure by C. Ken Weidner

C. KEN WEIDNER,[1] F. ASCE.—The discussions by Messrs. Lindvall, Grinter, Ingersoll, and Hotes are deeply appreciated. In an attempt to shed more light on points that apparently were obscure, the writer offers the following comments.

The statement that seems to have been most misconstrued is, "One cannot deny that the Christian concept of life as practiced is based primarily on fear of the hereafter; and one cannot deny that fear in some form dominates our lives in the United States." A full discussion of what lies behind this statement would produce a lengthy paper in itself. The fact that it is misunderstood by most Americans is proof of the success of the American Revolution; by separating church from state for the first time in the written history of man, it brought such complete religious freedom in the United States that Americans can no longer comprehend the lurking fear that exists in Christian countries in which church and state are substantially one and in which religion is political.

The first part of the writer's statement was an agreement with the concept of the foreign observer he had in mind. The second part was an acceptance of the fact that there is reason for such observers to translate the socio-economic fears of Americans that the writer enumerates, into a basic religious fear as it exists in Christiandom, outside of the Anglo-Saxon world, in general, and in the United States, in particular.

The writer has an abiding faith in the non-denominational Protestant Christian Ethic that spawned the American Revolution and established and developed the United States. But his experience has taught him that the basic dogmatic concepts that made possible the Borgias, the Inquistition, the atrocities of the Thirty Years War, the horrors of the Orthodoxy of the Czars of Imperial Holy Russia and of Christian Nazi Germany, are still rooted deep in the so called Christian Dogmas and will reassert themselves whenever an opportunity presents itself. Christianity, as a positive spiritual expression of unselfish love, as most Americans like to think of it, is not what the writer was discussing. Rather, he was discussing the un-American religious concept of dogmatic Christian politics and government that has nothing to do with the teachings of Jesus of Nazareth.

We must remember that Russia is what she is today largely because of what she was under the government of the Christian Czars of Holy Russia.

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[a] December, 1958, by C. Ken Weidner.

[1] Dean of Engrg. Faculty, Amer. Univ. of Beirut, Beirut, Lebanon.

[2] The Author will supply copies of "The Founding Concepts and Operating Philosophy of the School of Engineering, A.U.B.," to anyone who writes to him.

Most Americans will promptly say, "Oh but that is not what we mean by Christianity;" that is just the point. Things are not what we want them to be simply because we have another meaning for their names.

Having gone this far with the discussion of this phase of the problem, the writer feels compelled to pose, what to him is, the basic question about Russia vis-a-vis with the United States.

It is not considered possible for a large segment of any population to honestly seek truth for long and remain atheistic. Hence, the intellectual renaissance of post-Stalin Russia must, before long, induce an equally great spiritual renaissance within its population. Red China, with its spiritual heritage, is a very potent additional threat to the so called "Feee World." Whereas many may hope that China will neutralize Russia, it seems unwise to ignore the possibility of the more spiritually motivated one absorbing the other. The writer feels that our individual and collective concern should be preparing an America that will be dynamically strong enough in intellectual development, spiritual concepts, and practices to successfully compete with the new Red colossus, regardless of what form or direction its then spiritually inspired scientific technology takes. To the writer, this simply stated problem is the synthesis of the American problems of this century.

Another item which appears to need amplification is the writer's idea of a pilot-plant institution for professional engineering education.

The writer is convinced that engineering will remain more of a technological trade than a learned profession until engineering recasts its education within its own professional discipline leading to its own professional degrees. The programs leading to degrees in Science and Philosophy, by the very nature of their disciplines preclude the inclusion of the concepts of engineering as a practicing profession dedicated to "Service to Humanity." Just so long as engineering continues to frame its programs to fit within the progress of the academic disciplines, rather than its own professional discipline, just that long will engineering education fail to produce adequate professional graduates.

Whereas the controlled experment we are operating here in Beirut may not be entirely applicable to schools in the United States, its lack of adaptability would come largely from local resistance to change. The principles that we are following are, we believe, applicable wherever professional engineering education is desired. Our program, that leads to degrees of New York standards in Engineering, not Science, is at present 6 yr old and is recognized as adequate for license by all the local licensing bodies in the countries of the Middle East. It does not go as far as the writer is recommending. But our successful experience with this approach convinces him that if engineering is to emerge as a profession from the present confusion of scientific technology, the practicing profession must make a basic decision, such as the Medical Profession made at the turn of the century, and insist on broad general professional education for a basic 7 yr ending with a Doctorate in its own professional discipline. In the case of Medicine, it is the Doctor of Medicine. In the case of Engineering it is the Doctor of Engineering.

However, the writer does not propose dividing the non-professional and the professional education horizontally as Medicine does at present. It has been found that far better results are obtained if the so-called non-professional part of the program runs parallel to the engineering program throughout the whole period. Not only does the student gain more from having a cultural and management program, that increases in weight of content as he matures, but

by being exposed to the whole spectrum of the integrated program throughout his student period, be becomes a responsible, integrated, cultured, professional personality before graduation.

The writer's many conversations with his colleagues in the Medical faculty lead him to believe that if the Medical Profession had the opportunity to recast its educational program it would eliminate the horizontal division between the non-professional and professional programs and run them parallel throughout the whole 7 yr, as he recommends for engineering.

There is also the problem of developing the skill of the kinesthetic and subconscious capacities that can only be achieved by constant practice. If engineering work is preceded by non-engineering work in other disciplines, not only is valuable time of skill development, both mental and physical, lost, but the student usually spends that period acquiring intellectual and physical habits that are detrimental to the study of engineering as a practicing profession.

The proposed program would include a B.Sc. and a B.A., granted at the appropriate time in the program. These would not only provide culling points, but would also qualify the graduate to do whatever specialized graduate work he desired in the academic disciplines.

The writer is convinced that the time is ripe for the establishment of such an experimental school of professional engineering. He is also convinced that it would be eminently successful if tried.[2]

Note: The word "professional" is used in its basic concept in this paper and discussion. It is not tied to or limited by the "legal right to practice," phase of the problem.

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[2] The author will supply copies of "The Founding Concepts and Operating Philosophy of the School of Engineering, A.V.B.," to anyone who writes to him.

PROCEEDINGS PAPERS

The technical papers published in the past year are identified by number below. Technical-division sponsorship is indicated by an abbreviation at the end of each Paper Number, the symbols referring to: Air Transport (AT), City Planning (CP), Construction (CO), Engineering Mechanics (EM), Highway (HW), Hydraulics (HY), Irrigation and Drainage (IR), Pipeline (PL), Power (PO), Sanitary Engineering (SA), Soil Mechanics and Foundations (SM), Structural (ST), Surveying and Mapping (SU), and Waterways and Harbors (WW), divisions. Papers sponsored by the Department of Conditions of Practice are identified by the symbols (PP). For titles and order coupons, refer to the appropriate issue of "Civil Engineering." Beginning with Volume 82 (January 1956) papers were published in Journals of the various Technical Divisions. To locate papers in the Journals, the symbols after the paper number are followed by a numeral designating the issue of a particular Journal in which the paper appeared. For example, Paper 2703 is identified as 2703(ST1) which indicates that the paper is contained in the first issue of the Journal of the Structural Division during 1961.

VOLUME 86 (1960)

JANUARY: 2331(EM1), 2332(EM1), 2333(EM1), 2334(EM1), 2335(HY1), 2336(HY1), 2337(EM1), 2338(EM1), 2339(HY1), 2340(HY1), 2341(SA1), 2342(EM1), 2343(SA1), 2344(ST1), 2345(ST1), 2346(ST1), 2347(ST1), 2348(EM1)[c], 2349(HY1)[c], 2350(ST1), 2351(ST1), 2352(SA1)[c], 2353(ST1)[c], 2354(ST1).

FEBRUARY: 2355(CO1), 2356(CO1), 2357(CO1), 2358(CO1), 2359(CO1), 2360(CO1), 2361(PO1), 2362(HY2), 2363(ST2), 2364(HY2), 2365(SU1), 2366(HY2), 2367(SU1), 2368(SM1), 2369(HY2), 2370(SU1), 2371(HY2), 2372(PO1), 2373(SM1), 2374(HY2), 2375(PO1), 2376(HY2), 2377(CO1)[c], 2378(SU1), 2379(SU1), 2380(SU1), 2381(HY2)[c], 2382(ST2), 2383(SU1), 2384(ST2), 2385(SU1)[c], 2386(SU1), 2387(SU1), 2388(SU1), 2389(SM1), 2390(ST2)[c], 2391(SM1)[c], 2392(PO1)[c].

MARCH: 2393(IR1), 2394(IR1), 2395(IR1), 2396(IR1), 2397(IR1), 2398(IR1), 2399(IR1), 2400(IR1), 2401(IR1), 2402(IR1), 2403(IR1), 2404(IR1), 2405(IR1), 2406(IR1), 2407(SA2), 2408(SA2), 2409(HY3), 2410(ST3), 2411(SA2), 2412(HW1), 2413(WW1), 2414(WW1), 2415(HY3), 2416(HW1), 2417(HW3), 2418(HW1)[c], 2419(WW1)[c], 2420(WW1), 2421(WW1), 2422(WW1), 2423(WW1), 2424(SA2), 2425(SA2)[c], 2426(HY3)[c], 2427(ST3)[c]

APRIL: 2428(ST4), 2429(HY4), 2430(PO2), 2431(SM2), 2432(PO2), 2433(ST4), 2434(EM2), 2435(PO2), 2436(ST4), 2437(ST4), 2438(HY4), 2439(EM2), 2440(EM2), 2441(ST4), 2442(SM2), 2443(HY4), 2444(ST4), 2445(EM2), 2446(ST4), 2447(EM2), 2448(SM2), 2449(HY4), 2450(ST4), 2451(HY4), 2452(HY4), 2453(EM2), 2454(EM2), 2455(EM2)[c], 2456(HY4)[c], 2457(PO2)[c], 2458(ST4)[c], 2459(SM2)[c].

MAY: 2460(AT1), 2461(ST5), 2462(AT1), 2463(AT1), 2464(CP1), 2465(CP1), 2466(AT1), 2467(AT1), 2468(SA3), 2469(HY5), 2470(ST5), 2471(SA3), 2472(SA3), 2473(ST5), 2474(SA3), 2475(ST5), 2476(SA3), 2477(ST5), 2478(HY5), 2479(SA3), 2480(ST5), 2481(SA3), 2482(CO2), 2483(CO2), 2484(HY5), 2485(HY5), 2486(AT1)[c], 2487(CP1)[c], 2488(CO2)[c], 2489(HY5)[c], 2490(SA3)[c], 2491(ST5)[c], 2492(CP1), 2493(CO2).

JUNE: 2494(IR2), 2495(IR2), 2496(ST6), 2497(EM3), 2498(EM3), 2499(EM3), 2500(EM3), 2501(SM3), 2502(EM3), 2503(PO3), 2504(WW2), 2505(EM3), 2506(HY6), 2507(WW2), 2508(PO3), 2509(ST6), 2510(EM3), 2511(EM3), 2512(ST6), 2513(HW2), 2514(HY6), 2515(PO3), 2516(EM3), 2517(WW2), 2518(WW2), 2519(EM3), 2520(PO3), 2521(HY6), 2522(SM3), 2523(ST6), 2524(HY6), 2525(HY6), 2526(HY6), 2527(IR2), 2528(ST6), 2529(HW2), 2530(IR2), 2531(HY6), 2532(EM3)[c], 2533(HW2)[c], 2534(WW2), 2535(HY6)[c], 2536(IR2)[c], 2537(PO3)[c], 2538(SM3)[c], 2539(ST6)[c], 2540(WW2)[c].

JULY: 2541(ST7), 2542(ST7), 2543(SA4), 2544(ST7), 2545(ST7), 2546(HY7), 2547(ST7), 2548(SU2), 2549(SA4), 2550(SU2), 2551(HY7), 2552(ST7), 2553(SU2), 2554(SA4), 2555(ST7), 2556(SA4), 2557(SA4), 2558(SA4), 2559(ST7), 2560(SU2)[c], 2561(SA4)[c], 2562(HY7)[c], 2563(ST7)[c].

AUGUST: 2564(SM4), 2565(EM4), 2566(ST8), 2567(EM4), 2568(PO4), 2569(PO4), 2570(HY8), 2571(EM4), 2572(EM4), 2573(EM4), 2574(SM4), 2575(EM4), 2576(EM4), 2577(HY8), 2578(EM4), 2579(PO4), 2580(EM4), 2581(ST8), 2582(ST8), 2583(EM4)[c], 2584(PO4)[c], 2585(ST8)[c], 2586(SM4)[c], 2587(HY8)[c].

SEPTEMBER: 2588(IR3), 2589(IR3), 2590(WW3), 2591(IR3), 2592(HW3), 2593(IR3), 2594(IR3), 2595(IR3), 2596(HW3), 2597(WW3), 2598(IR3), 2599(WW3), 2600(WW3), 2601(WW3), 2602(WW3), 2603(WW3), 2604(HW3), 2605(SA5), 2606(WW3), 2607(SA5), 2608(ST9), 2609(SA5)[c], 2610(IR3), 2611(WW3)[c], 2612(ST9)[c], 2613(IR3)[c], 2614(HW3)[c].

OCTOBER: 2615(EM5), 2616(EM5), 2617(ST10), 2618(SM5), 2619(EM5), 2620(EM5), 2621(ST10), 2622(EM5), 2623(SM5), 2624(EM5), 2625(SM5), 2626(SM5), 2627(EM5), 2628(EM5), 2629(ST10), 2630(ST10), 2631(PO5)[c], 2632(EM5)[c], 2633(ST10), 2634(ST10), 2635(ST10)[c], 2636(SM5)[c].

NOVEMBER: 2637(ST11), 2638(ST11), 2639(CO3), 2640(ST11), 2641(SA6), 2642(WW4), 2643(ST11), 2644(HY9), 2645(ST11), 2646(HY9), 2647(WW4), 2648(WW4), 2649(WW4), 2650(ST11), 2651(CO3), 2652(HY9), 2653(HY9), 2654(ST11), 2655(HY9), 2656(HY9), 2657(SA6), 2658(WW4), 2659(WW4)[c], 2660(SA6), 2661(CO3), 2662(CO3), 2663(SA6), 2664(CO3)[c], 2665(HY9)[c], 2666(SA6)[c], 2667(ST11)[c].

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c. Discussion of several papers, grouped by divisions.

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